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记山东山旺钝吻鳄（*Alligator*）一新种

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关键词　山东山旺　中新世　钝吻鳄

内　容　提　要

本文记述了钝吻鳄一新种（*Alligator luicus*）。这是鳄类化石在山东山旺中新统的首次发现，它为探讨钝吻鳄属的早期历史提供了新的资料。

一九八四年山旺化石保护所的工作人员在山旺中新世脊椎动物化石地点发现了一钝吻鳄的头骨及部分头后骨骼，这是鳄类化石在山旺的第一次发现。山旺脊椎动物群的内容异常丰富，包括自鱼至哺乳动物化石的三十几个属种（阎德发等 1983），但其中爬行动物化石数量稀少，仅有蛇、龟鳖的零星材料被报道。此次鳄类化石的发现无疑地丰富了山旺脊椎动物群的内容，同时为研究钝吻鳄在亚洲的早期历史提供了新资料。

钝吻鳄 *Alligator*

鲁钝吻鳄 *Alligator luicus* sp. nov.

正型　一近于完整的头骨，破碎的下颌，及部分头后骨骼。临朐古生物博物馆标本号850001。

地点及层位　山东省临朐县尧山乡山旺，山旺组中部，中中新世。

特征　头骨短小；表面颅刻纹发育；吻的长度小于颅区长度，吻的基部宽度大于其吻长；上颌骨与前额骨，鼻骨与泪骨互成对角接触；眶前嵴不发育；上颞凹较宽大，呈长椭圆形。

描述　山旺标本为一较小的鳄类个体，头骨仅长105毫米。象钝吻鳄的其它种一样，头骨扁平，且相当宽，吻端浑圆，头骨顶面观为舌状。其上的一对眼孔十分宽大。上颞凹占据了颅平台的相当大的部分，呈长椭圆形，其长宽之比为5:3。

头骨表面的颅刻纹十分发育。在颅平台上它们为密集的，大而深的凹坑；在鼻骨上，这些凹坑纵向拉长，其后部的较浅；在前颌骨和上颌骨上它们为较小的麻点状，形态和分布都很不规则。

头骨的一个很重要的特征是它的吻部短而宽，几个比例数字可以很清楚地说明这点：它的吻长50毫米，只占整个头长的47.6%；而吻基部宽55毫米，为吻长的1.1倍。这种情况在钝吻鳄中，即使在它们的幼年个体中，也是极为罕见的（*Alligator* 其它种头骨的比例

见 Mook 1946 表 2)。

前颌骨环围着宽大的外鼻孔。和钝吻鳄的大多数成员 (*A. mississippiensis*, *A. sinensis*, *A. mefferd*, *A. mcgrewi* 等)一样,前颌骨后突伸入两外鼻孔间,与鼻骨的前突相接,形成完整的鼻中隔。前颌骨自吻的外缘向外鼻孔方向舒缓地上升,但除最后部外,在外鼻孔的周围并未形成环形的嵴。

上颌骨宽大,与鼻骨的接缝短,它与前额骨成对角接触。左上颌骨后部略有破损,右上颌骨完整。顶视可见上颌骨的边缘,在与前颌骨的接触处及它的后部,略有收缩。在侧视面上,上颌骨边缘的波状弯曲不明显。

鼻骨短宽,它的顶面两侧缘稍高,向中线方向倾斜。但在纵向上,两头高中间低的现象并不明显。鼻骨前部圆滑地向前收缩,呈一短粗的前突伸入外鼻孔。

前额骨小于泪骨。它的后外侧缘略高于眼眶的前缘。但升高部分向前延伸十分有限,无法与钝吻鳄其它种中的眶前嵴 (Preorbital crests) 相比,也许这仅仅是眶前嵴的雏形。前额骨的顶面向前内侧倾斜,它们与同侧鼻骨位于同一斜面内。

泪骨的前端超过前额骨,它与鼻骨成对角接触。与前额骨相反,它的内侧缘稍高,使骨片的表面向外侧倾斜。

额骨的中部狭窄,两侧的颅刻纹大致以中线为对称。在眼眶的边缘额骨稍稍升高,呈嵴状。额骨的前延部分,夹于左、右前额骨中间,呈一窄长的凹沟。它与额骨的中部不处于同一水平面内,二者之间形成一明显的角度,但在转折处未见横向的嵴。额骨的后缘近似弧状,未伸抵上颞凹。

顶骨在间颞部的最小宽度(11 毫米)大于上颞凹的横径(9 毫米)。顶骨后延至颅平台的后缘,在其中占据了相当大的部分。由于上颞凹的宽大,使颅平台上的眶后骨和鳞骨都相对较小。眶后棒明显下沉。这一部位的突出特点是颅平台的前部宽度与后部宽度几乎相等。

颧骨自前端与上颌骨的接触处向后,略向外侧延伸,形成眼眶的外缘。虽然这一头骨极端扁平,但由于颧骨的位置低于额骨,使眼眶面向斜上方。

方骨主支的后部在顶面上可以很清楚地观察到,它较为短粗,仅有很小的一段超出颅平台后缘一线。与其它鳄类方骨强烈地向后下方倾斜不同,在山旺标本中这一骨片近于水平方向,这可能与它的头骨扁平一致,也可能是埋藏时受到垂直方向的压力所造成的。左侧可见方骨髁位于下颌的关节窝内,方骨关节轴水平延伸。

头骨后腹部受损,使枕面一些特征难于辨认。枕部只有上枕骨、部分外枕骨保存,基枕骨缺失,枕骨大孔形态不清。基蝶骨的大部分和翼骨中部缺失,因此无法了解内鼻孔的精确位置。由于破碎的下颌骨压复在它的腹面,使头骨腹面的其它特征也难于辨认。

下颌仅仅保存了前端的缝合部和左下颌支的后部,可以分辨的特征有下述几方面:下颌缝合线属短的类型。标本可见第四下颌齿尚未达到缝合线的最后的部位,它无疑地类似于扬子鳄下颌缝合线可以伸达第五下颌齿的部位;而不同于密西西比鳄仅伸达第三下颌齿。夹板骨伸入下颌缝合部。外下颌孔狭长。与横宽的方骨髁相应,关节骨形成较宽的下颌关节窝。左下颌支最后端破损,但保存部位暗示出它的反关节突较短。

齿列 上下颌边缘破损,使齿列保存不完整,齿孔数目也无法统计。现有资料仅可以

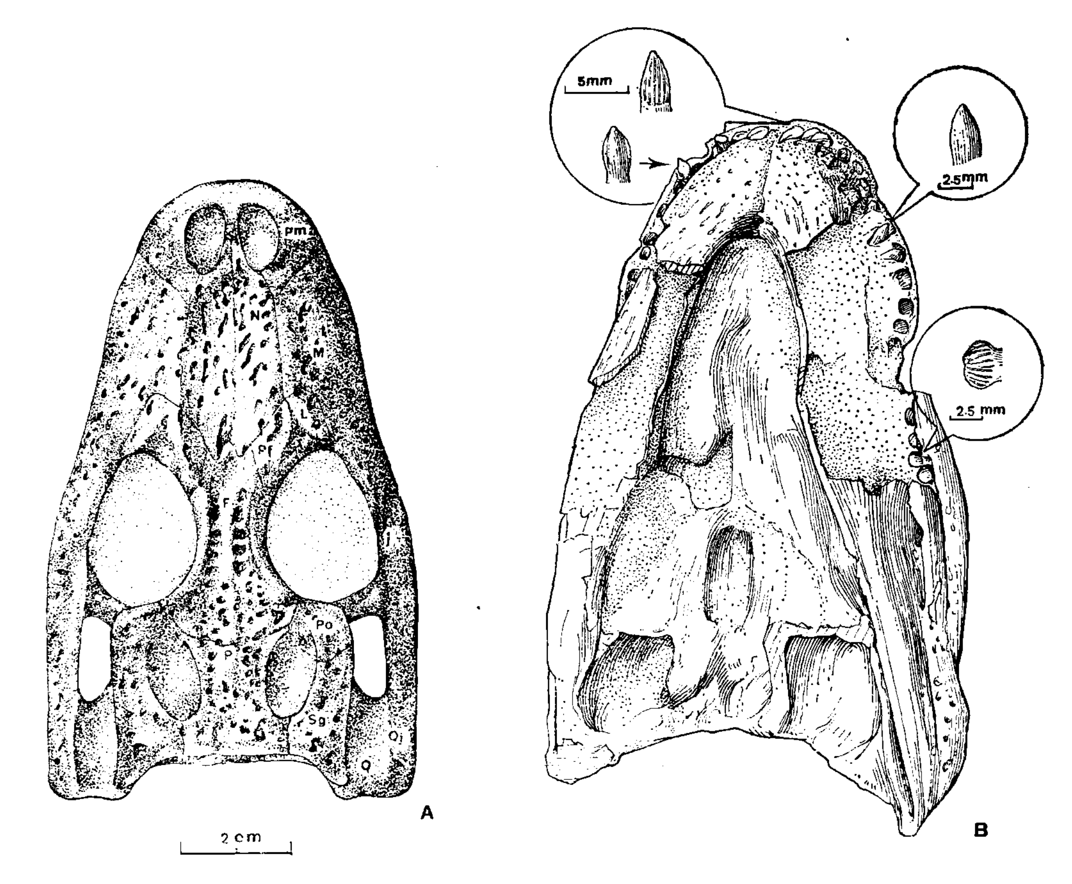


图 1　鲁钝吻鳄，新种（*Alligator luicus* sp. nov.）

A 头骨背视，B 头骨部分下颌腹视及牙齿形态

简字说明：F 额骨，J 颧骨，L 泪骨，M 上颌骨，N 鼻骨，P 顶骨，Pf 前额骨，Pm 前颌骨，Po 眶后骨，Q 方骨，Qj 方颧骨

说明下列几点：

前颌骨齿列在埋藏时发生变形，牙齿都向右侧倾斜，但在整个头骨中它保存得最为完整。每侧有 5 个前颌骨齿，第 1、2 齿较小，第 3 齿增大。右侧第 4 齿未保存，左第 4 齿牙冠断失，遗留的牙基部断面显示第 4 齿最大。右第 5 齿完整，为一个较小的牙齿。前颌骨齿呈扁锥状，具较为尖锐的侧缘。牙齿微向舌面弯曲，基部收缩为一细颈。它们的表面光滑，或具稀疏的纵向条纹。

上颌骨齿大部缺失，保存的齿孔表明它和钝吻鳄的其它种一样，牙齿的大小交替变化，位于波曲峰部的牙齿较大，而位于波曲谷部的牙齿较小。左侧第 2 上颌齿为一新生齿，齿尖刚刚自齿孔伸出，由于齿孔的内壁破损可以观察到整个的齿冠。它也呈扁锥状，只是略宽于前颌骨齿，表面的纵纹也较前颌骨齿发育。

左上颌骨的后部断裂，压复到头骨的腹面，但着生其上的最后三个上颌齿得以保存。它们与前部上颌骨齿的形态截然不同。齿冠短小而粗壮，侧视面上牙齿为扁凿状，顶部圆弧形，基部收缩，表面布满细密的纵纹。这块断裂的上颌骨并未发生前后的位移，它刚好

表 1 标 本 测 量

身长(包括头骨)	Body length (including skull)	600 mm
头长(吻端—颅平台后缘)	Skull length (tip of snout to posterior border of cranial table)	105 mm
吻长(吻端—眼眶前缘)	Snout length (tip of snout to anterior border of orbit)	50 mm
颅区长(眼眶前缘—颅平台后缘)	Length (anterior border of orbit to posterior border of cranial table)	55 mm
头宽(颅平台后缘)	Skull breadth at the level of posterior border of cranial table	66 mm
吻前宽(外鼻孔中点)	Snout breadth at the level of middle point of external nares	36 mm
吻基部宽	Snout breadth at base	55 mm
颅平台前宽	Cranial table breadth at anterior border	41 mm
颅平台后宽	Cranial table breadth at posterior border	41 mm
眶间宽	Interorbital breadth	9 mm
颞间宽	Intertemporal breadth	11 mm
外鼻孔长	External nares length	12 mm
外鼻孔宽	External nares breadth	7 mm
眼眶长	Orbit length	30 mm
眼眶宽	Orbit breadth	22 mm
上颞凹长	Supratemporal fenestra length	15 mm
上颞凹宽	Supratemporal fenestra breadth	9 mm

位于眼眶的下方。以此判断在上颌齿列的最后部位,有 4 个牙齿位于眼眶的侧下方。

下颌的前端保存了几个牙齿，由于压在前颌骨齿列的内侧，影响了对它们形态的观察。但标本上清楚地显示出牙齿之间有较大的间隔,它们是向前上方伸出的,这样在下颌关闭时上下齿就互相交错,与扬子鳄的幼体、食鱼鳄（*Gavial*）及马来鳄（*Tomistoma*）的情况相似(丛林玉等 1984)。

头后骨骼虽然看上去完整,但保存状态不佳。除了个别不完整的肢骨(肱骨、股骨、胫骨、腓骨、趾骨等)外,其余的只是膜糊的痕迹,各骨片的形态,脊椎的数目都无法详述。

比较与讨论 山旺标本的各项特征无可争辩地表明它是钝吻鳄属的一个成员，在此重点讨论它与钝吻鳄其它种的关系。

钝吻鳄的不同种个体大小有很大差异,现生种密西西比鳄(*A.mississippiensis*)体长可达 6 米;而扬子鳄（*A.sinensis*）仅为 2 米左右。头长 105 毫米,体长 600 毫米左右的山旺标本应代表一个较小的个体。 依据丛林玉等(1984)的测量，头长 81 毫米，体长 580—650 毫米的扬子鳄是较大的幼体;而头长 121 毫米,体长 930 毫米的为成体。 如果以扬子鳄的生长为标准，山旺标本似乎代表着一个尚未达到性成熟的较大的幼年个体。 它头骨上的一些特征,如上颌边缘波曲不发育,吻部短小等也证明了这点。

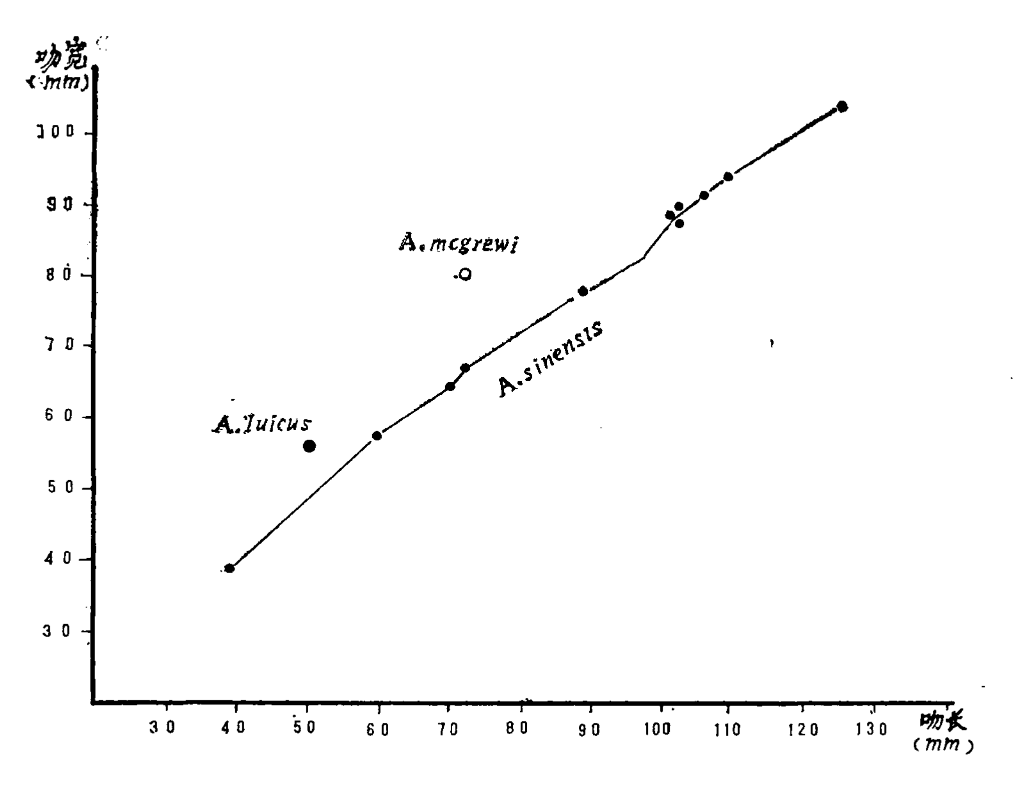


图 2　*A. sinensis*, *A. luicus* 和 *A. mcgrewi* 吻部长宽比例示意图

山旺标本与扬子鳄的幼年个体比较，二者之间确实存在着许多相似之处。如它们的头骨都宽而短，颅区长度都大于面区长度；上颌骨边缘波曲不明显；颅平台的前部宽度与后部宽度相等；前方下颌齿的尖端向外倾斜，当下颌关闭时与前颌齿成犬牙交错的对合；眼眶宽大，其长度都为颅长的 29% 左右；它们的上颞凹大小和形状也十分相似。

山旺标本在下述各点与扬子鳄的幼体明显不同：它的吻部比扬子鳄的吻部更为短宽，极为罕见的是它吻基部的宽度大于吻的长度。鳄类在个体发育的过程中吻区的增长速度大于颅区的增长速度；而吻区长度的增长远大于吻区宽度的增长。头长 81 毫米的扬子鳄吻区长度与基部宽度相等(丛林玉等 1984)，如果以它为标准推论，在与山旺标本大小相同的扬子鳄中吻区长度应大于吻基部宽度。

在扬子鳄中上颌骨与前额骨的接触，阻隔了泪骨与鼻骨；而在山旺标本中这两对骨片都成对角相接。

鳄类头骨顶面的颅刻纹饰，及由此刻纹所组成的嵴、结节和隆凸，在幼体十分微弱，个体越大，这些结构越发达，颅表面也越粗糙。一般来说，山旺标本大于头长 81 毫米的扬子鳄，它头骨顶面的颅刻纹及派生构造应较后者发育，而现在情况并不完全如此。在头长 81 毫米的扬子鳄中，虽然它吻正中嵴的后端尚未形成，但颅正中嵴和眶前嵴系统均已十分发育；而在山旺标本中，虽然颅刻纹清晰，但颅正中嵴和眶前嵴系统都没有形成。

与山旺标本在形态上最为接近的是产于北美 Nebraska 早中新世最晚期 Marseland 组的 *Alligator mcgrewi* Schmidt 1941。这一钝吻鳄的头骨稍大于山旺标本，头长 138.4

毫米,吻长 71.4 毫米,吻基部宽 80 毫米。原作者认为它是一个“at least more than half grown individual”。它的头骨极为短宽,与山旺标本一样吻基部宽度大于吻长(图 2),它也同样没有眶前嵴。但二者的区别也是明显的,*A. mcgrewi* 上颞凹的宽度大于顶骨的间颞部宽度和鳞骨—眶后骨组成的颅平台外缘的宽度。而山旺标本上颞凹的形态要显得窄长一些,接近于 *A. sinensis* 的形态。*A. mcgrewi* 的外鼻孔大,几乎伸抵吻的前缘,鼻孔周围形成明显的嵴,这与山旺标本的前颌骨倾斜平缓形成对照。*A. mcgrewi* 的泪骨与鼻骨由于受到上颌骨与前额骨的阻隔,未形成接触。

从以上的比较可以看出,山旺标本以一些特征区别于已知的钝吻鳄的种。虽然作为一个未成年个体,随着年龄的增长有些特征会随之变化,如由于吻区长度的增长大于颅区和吻宽度的增长,在这一种动物的成体中吻长会大于颅区长和吻基部宽。但与扬子鳄幼体及 *A. mcgrewi* 的 half grown 个体之间的差异表明山旺标本无疑可以代表钝吻鳄中的一个独立的种。种名取自化石产地山东省的简称“鲁”。

钝吻鳄的两个现生种分别生活于北美和中国。在北美已有 6 个化石种被发现(徐钦琦、黄祝坚 1984),它们自渐新世开始直到现代。虽然这些资料还不足以准确而详细地反映出钝吻鳄在美洲发展的历史,但人们可以大致推测出它们的进化趋向。由于多方面的原因,迄今为止,在中国还只有很少的钝吻鳄化石被发现和报道。它们包括产于南京浦镇中新世的钝吻鳄未定种 *Alligator* sp. (周明镇、王伴月 1964) 和安徽和县中更新世的 *Alligator* cf. *sinensis* (黄万波等 1982)。这两个地点都只有个别的牙齿被发现,与山旺标本很难对比。在这种情况下,保存较为完好的山旺标本的发现无疑地应具有较为重要的意义。

以前的研究者们 (Mook 1923, Steel 1973, 徐钦琦、黄祝坚 1984) 认为在北美的钝吻鳄中 *A. thomsoni* 与亚洲的 *A. sinensis* 形态相似,关系最为密切。他们假设在中新世时钝吻鳄向亚洲传播,在北美中新世的 *A. thomsoni* 与中国现代的 *A. sinensis* 之间一定有一个尚未被发现的联系环节。现在山旺标本的发现似乎并没有完全证实这点。作为钝吻鳄的成员,山旺标本和 *A. thomsoni*, *A. sinensis* 间有很多相似之处,但一些差异如眶前嵴的缺失,泪骨与鼻骨的接触又妨碍它架起 *A. thomsoni* 与 *A. sinensis* 之间的桥梁。目前的资料似乎暗示 *A.. mcgrewi* 和 *A. luicus* 沟通了北美与亚洲两大陆钝吻鳄之间的联系。

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A NEW SPECIES OF *ALLIGATOR* FROM SHANWANG, SHANDONG

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Key words Shanwang, Shandong; M. Miocene; *Alligator*

Summary

A crocodilian specimen is described and identified as a new species of *Alligator* in present paper. The material was collected from the Middle Member of the Shanwang Formation, Linqu County, Shandong Province by the members of the Linqu Paleontological Museum in 1984. Nearly 40 taxa of fossil vertebrates, including fishes, amphibians, reptiles, birds and mammals, have been reproted from this Miocene locality since 1930's (Yian et al. 1983, Qiu et al. 1986). Within the vertebrate fauna the fossil mammals and fishes are very rich, but the others are relatively rare. This is the first record of a crocodilan from the diatomaceous quarry of Shanwang.

Genus *Alligator* Curvier 1817
Species *A.. luicus* sp. nov.

Type An almost complete skull with part of lower jaws in occlusion and very indistinct postcranial skeleton.

Locality and horizon Shanwang Linqu County Shandong province. Middle shanwang Formation, Middle Miocene.

Diagnosis Skull small, short and wide, with blunt snout being wider than long, and shorter than the length of orbital and post-orbital region. Cranial sculpture developed, but preorbital ridges absent. Supratemporal fenestra large and oval. The contact of maxilla and prefrontal, nasal and lacrimal in form of opposite vertical angle separtely.

Description The skull is almost complete, and exhibits clearly typical alligator's character. It is very broad and short, with the proportion 62.9% of its breadth (at the level of posterior border of cranial table) to its length. The snout is broad and short too, and wider than long (the snout length 50 mm, the basal breadth 55 mm).

The premaxilla elevates smoothly from the snout margin to the external nares, but does not form a circle ridge around nares. The posterior process of premaxilla extends back to meet the nasals. The maxilla is large and broad. It shows very weak constriction in superior view

and faint undulation in lateral view. The maxilla and prefrontal come into contact with each other in a point, which appears to form a pair of opposite vertical angle, and does not exclude the lacrimal from contact with the nasal. The short suture of the nasal with the maxilla is in higher position than the midline, in which both nasals meet. But in longitudinal the nasal does not show any elevation at both anterior and posterior ends. The anterior end of lacrimal is at the same level of prefrontal's anterior end, although the prefrontal is larger than the lacrimal. The short suture of the prefrontal with the lacrimal elevates slightly to makes the surface of the prefrontal obligue inwards, but the lacrimal outwards. This small elevation may be the primary stage of preorbital ridges, which are present in *A. sinensis* and *A. mefferdi.*

The frontals are completely excluded from the edge of the supratemporal fenestrae. By comparison with the breadth of skull the interorbital plate is relatively narrow, and situated in a higher level than the base of snout. There is a distinct drop from the interorbital plate to the snout, but a transverse ridge between them is absent. The parietal is large in longitudinal and transverse direction and occupied slightly more than one-third of posterior border of the cranial table. As compared with large parietal and supratemporal fenestrae the postorbital and squamosal are relatively small. The breadth of anterior border of cranial table is equal to that of posterior one as in juveniles of *A. sinensis.*

The jugal is situated in a lower level than the frontal, that makes the orbital face dorsally and slightly laterally even though the skull is extremely flat. Corresponding to the flattened skull, the main ramus of quadrate extends backward almost horizontally, and only a small portion exceeds beyond the posterior border of cranial table. The axis of quadrate condyle is horizontal too.

The character if skull in posterior and ventral view could not be described in detail for the crush and distortion.

The anterior parts of lower jaws and posterior part of left ramus are preserved in occlusion with the skull. Several points could be detected. (1) The symphysis extends back to the level of the fifth dentary tooth as in *A. sinensis,* instead of the third as in *A. mississippiensis.* (2) The splenial appears to be included in the mandibular symphysis. (3) The external mandibular fenestra is long and narrow. (4) The preserved part of articular indecates the presence of a short retroarticular process, even though the posterior end is missing.

There are apperently 5 premaxillary teeth in each side. Within them the first, second and fifth are considerably small, while the fourth is the largest one. They are slightly curved inward, compressed oval in cross section, and are distinctly bladed on its anterior and posterior edges. There are faint, irregular rugose striations on the surface of crown. Most maxillary and dentary teeth are lost, so exact dentation formula is unknown. The second tooth present on left maxilla, is an immature that had recently replaced a predecessor. It is similar to premaxillary teeth in shape and character, but is slightly wider and more distinctly striated. The last four teeth on left maxilla are present, they are stout and low crowned, with more close striation, and are imbeded in a confluent groove. The anterior dentary teeth are present, but hided under the upper dentation. They are spaced moderatly far apart from each other, and are stretched upward and forward. When the jaw was closed, they must be interdigitated with the premaxillary teeth.

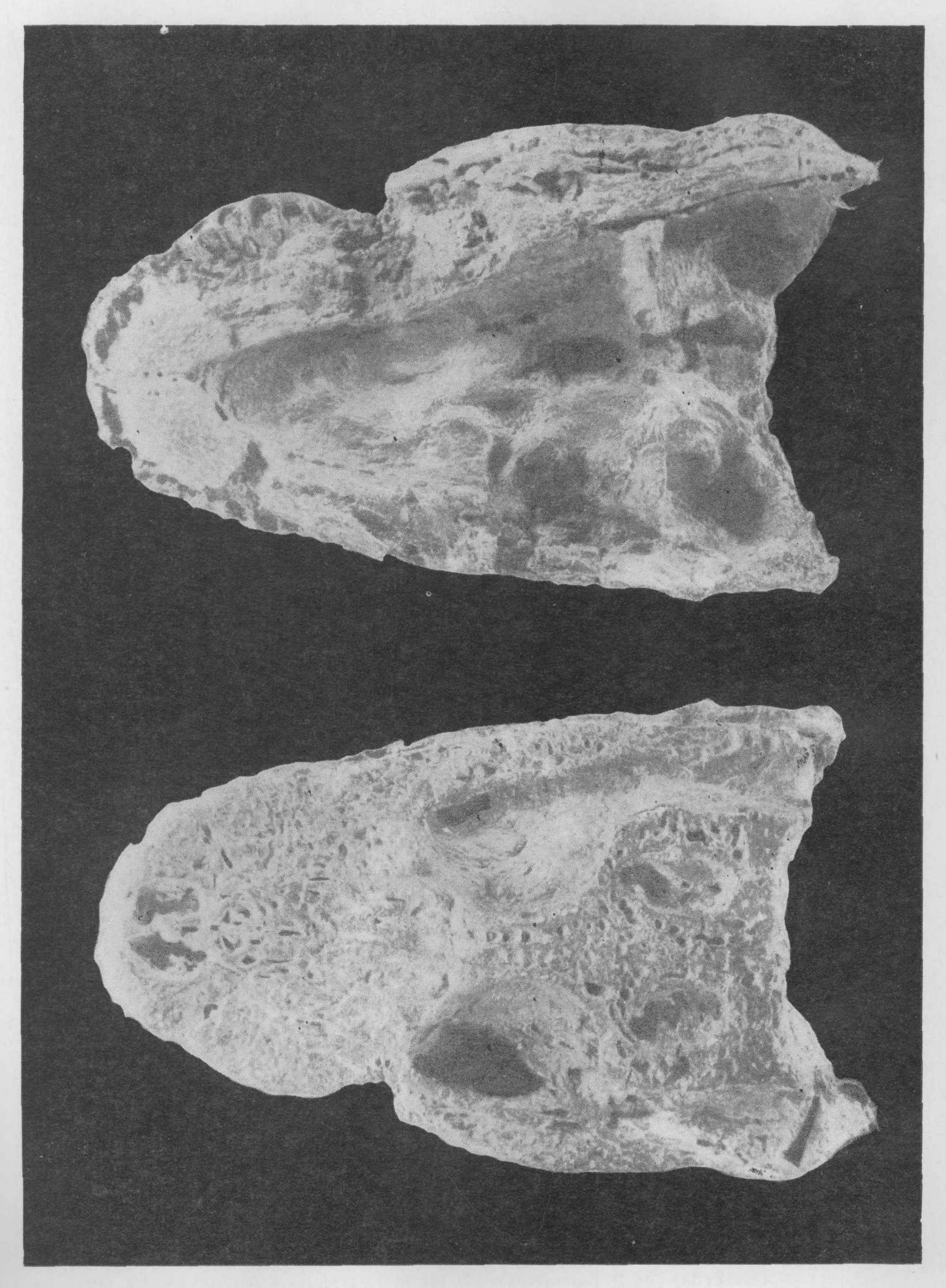
Discussion The specimen described is indisputable an alligator and appears to represent an immature individual. It resembles the juvenile of living species, *A. sinensis* in several respects— the extremely short and wide skull; the large orbit, which is 29% of skull length; the equal breadth of anterior and posterior border of cranial table; the shape and size of supra-

temporal fenestra; the oblique anterior dentary teeth, which are interdigital with the premaxillary teeth when the jaw is closed. But the differences between them are present conspicuously. In *A. luicus,* as mentioned above, the snout is wider than long, while in a same sized *A. sinensis* the snout is longer than wide. In contrast to a middle ridge and a preorbital ridge system in *A. sinensis,* there exist not an obvious preorbital ridge in *A. luicus.*

The closest species to *A. luicus* is *A. mcgrewi,* which was collected from Marseland Formation, uppermost Lower Miocene of Nebraska. *A. mcgrewi* has not a preorbital ridge either, and with the snout wider than long. But it is well distinguished from *A. luicus* by having a distinct bordering ridge of external nares, and a wide supratemporal fossae, which are wider than the outer bars of bone and the middle parietal bar.

As mentioned above the Shanwang alligator is an immature individual, by the characters of its skull it differs not only from other species of *Alligator,* but also from the same sized *A. sinensis* and *A. mcgrewi,* and definitly indicates a new species of *Alligator.* The species name is given from the short name of Shandong, where the specimen was collected.

It was suggested by Steel (1973) that the North American Miocene *Alligator,* short snouted *A. thomsoni* could have been antecedent to an unknown species which spread into Asia and became the progenitor of *A. sinensis.* The discovery of new species, *A. luicus,* does not proove the supposition completely, though it seems to serve partially to bridge the wide structural gap between *A. sinensis* of China and the North American alligator.



鲁钝吻鳄(新种)头骨背视、腹视×1
Dorsal and ventral view of the skull of *Alligator luicus* sp. nov. ×1



鲁钝吻鳄(新种)背视 ×3

Dorsal view of *Alligator luicus* sp. nov. ×3